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Supplementary Materials for

Defaunation affects carbon storage in tropical forests

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The PDF file includes:

Code file S1. Simulation code in R (Simulation_Code.RMD).
Code file S2. Read me (Simulation_Code.html).
Data file S1. Trait information of the 2014 species analyzed (Table S1_Trait Data. xls).
Data file S2. Community data example for the simulation code (prove_community.csv).
References (*188–214*)

Figures

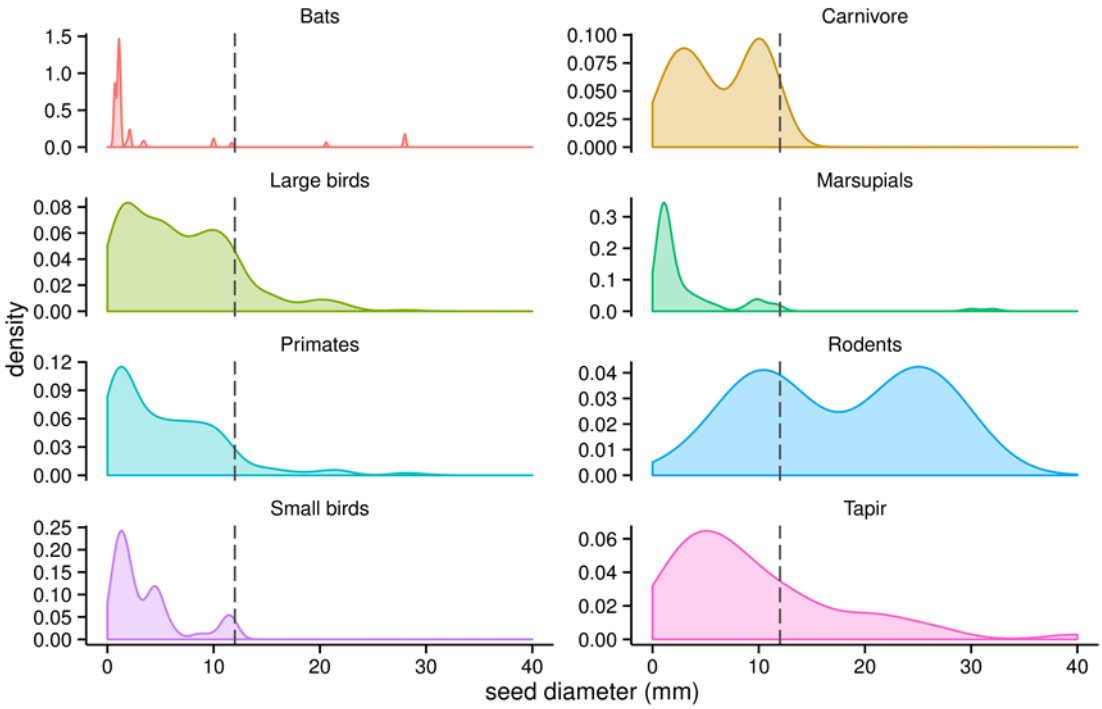

Figure S1. **Distribution function of seed size diameter (mm) dispersed by the major frugivores in the Atlantic forest, Brazil.** Small birds that are not game species have a maximum peak of dispersed seeds near to 12 mm of diameter indicated by the vertical dashed line. The dataset is based on published information on frugivores diet and plant dispersal assemblage from studies in the Brazilian Atlantic forest.

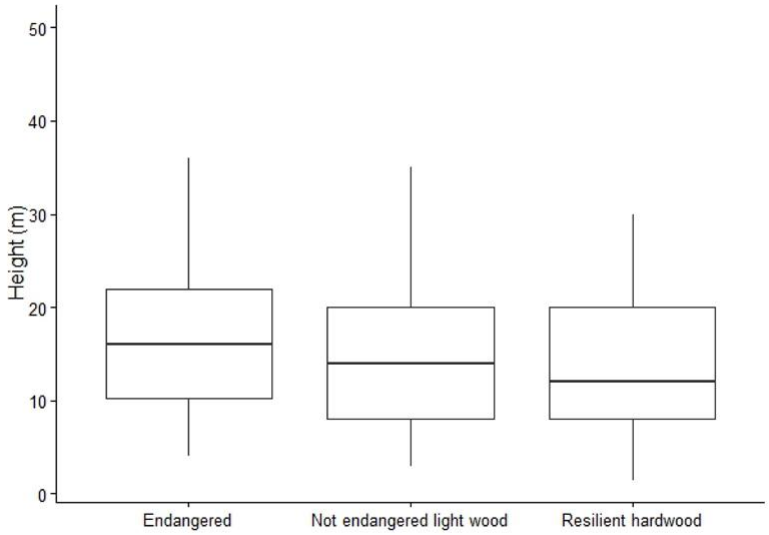

Figure S2.Maximun tree height by class of species according to seed diameter and wood density. Endangered are species with seed diameter≥12mm; Resilient hardwood are species with seed diameter<12mm and dense wood (>0.7g cm^{-3}); Not endangered light wood are species with seed diameter<12mm and light wood (<0.7g cm^{-3}).

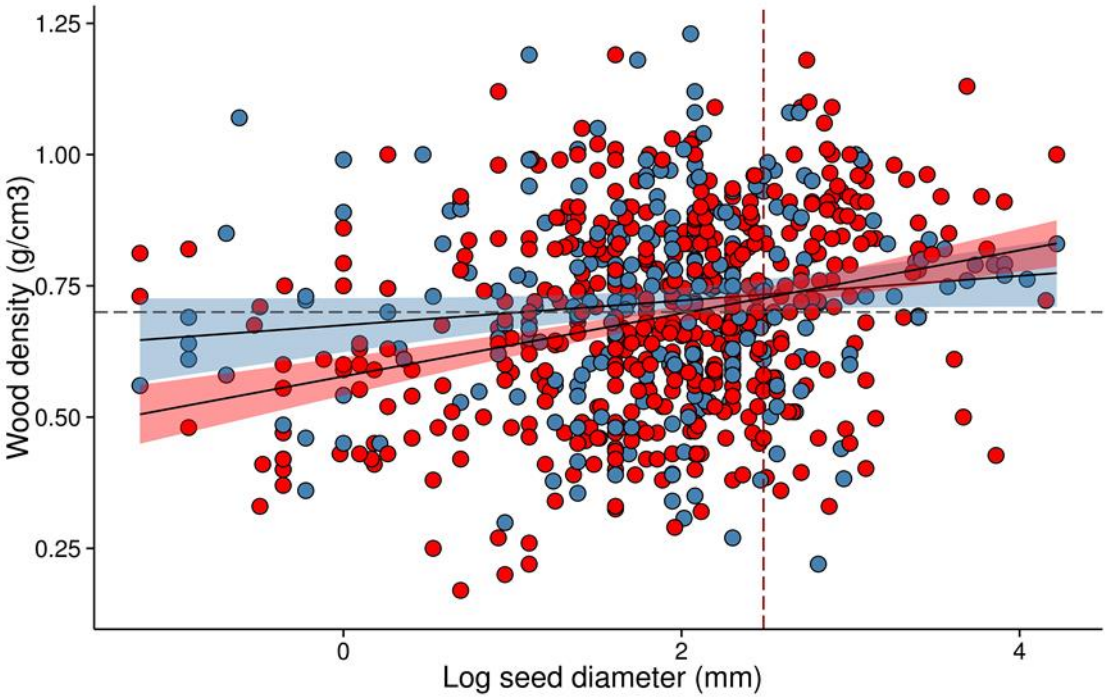

Figure S3. **Relationship between wood density and seed diameter by dispersal syndrome.** Animal-dispersed (red) and abiotically dispersed (blue) trees in the Brazilian Atlantic forest. Abiotic correlation (r_s= 0.11, p= 0.06, N=246). Zoochoric correlation (r_s= 0.28, p< 0.001, N=486). Red vertical line shows the seed diameter threshold of 12 mm. Black horizontal dashed line indicates the mean wood density of the whole dataset.

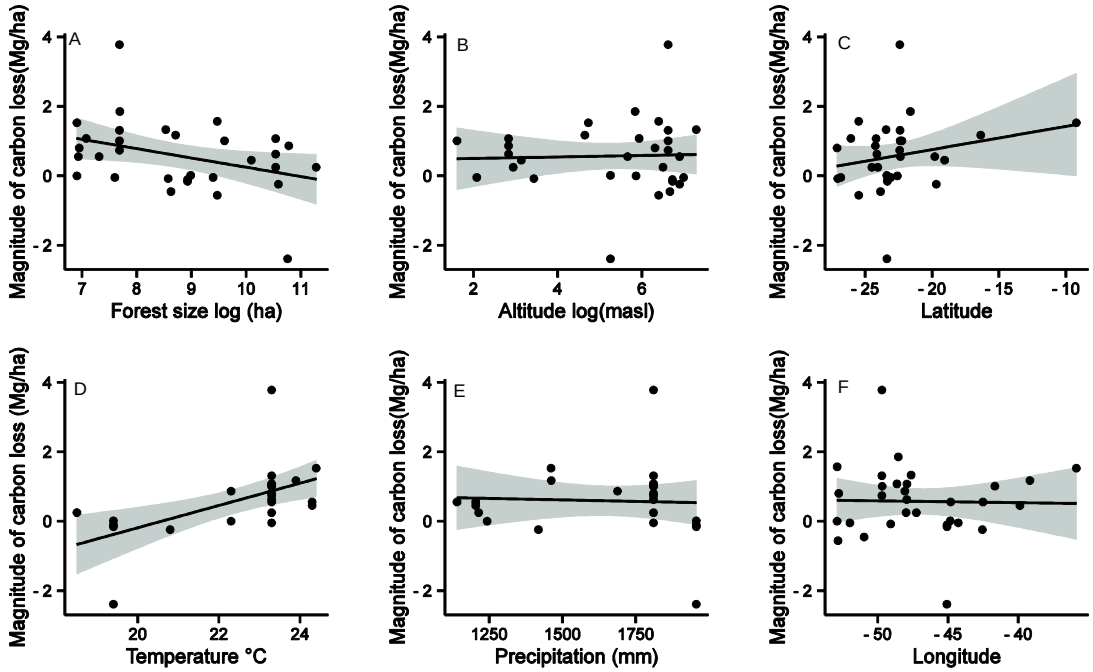

Figure S4. **Relationships between abiotical variables and magnitude of carbon loss.** A) Forest size, B) Altitude, C) Latitude, D) Temperature, E) Precipitation, F) Longitude. Gray line shows the tendency of the glm fitting model and the confidence interval

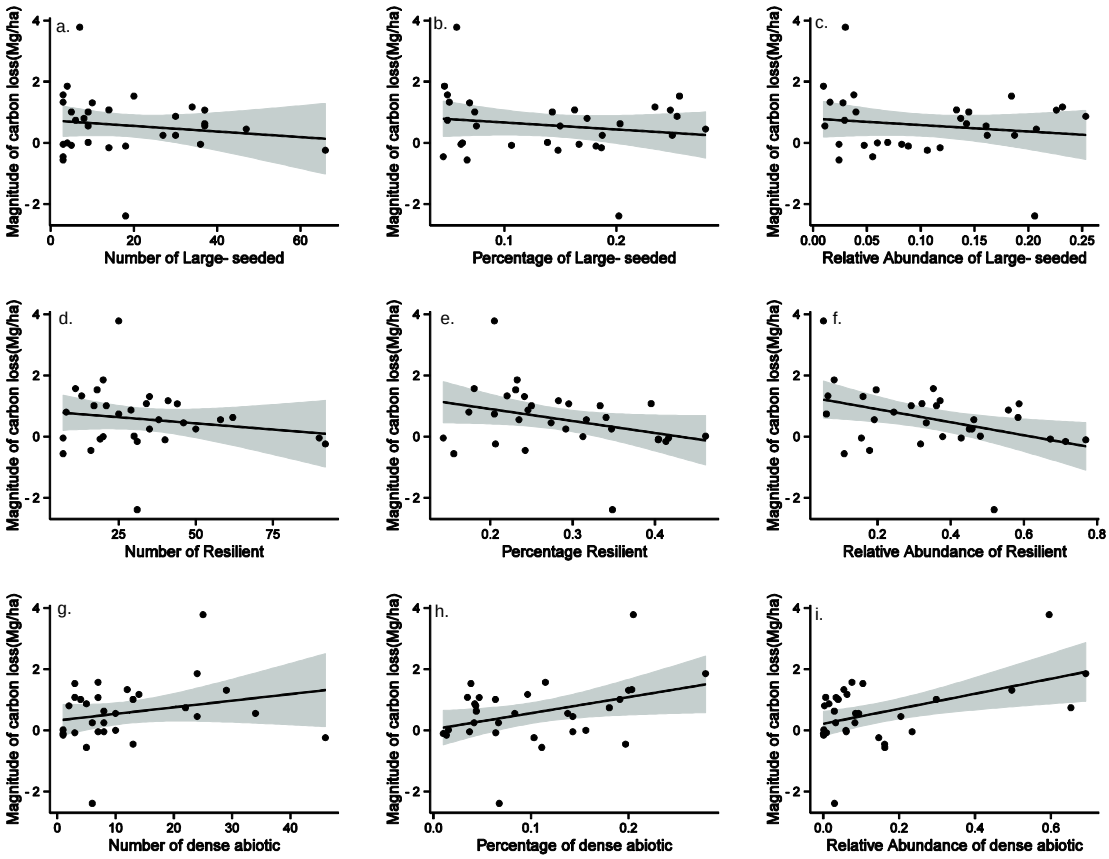

Figure S5. **Relationships between the compositional variables of each community and its magnitude of carbon loss**. A) Number of large-seeded species (seed size ≥ 12 mm), B) Percentage of large-seeded species, C) Relative Abundance of large-seeded species , D) Number of Resilient species(seed size < 12 mm and wood density>0.7 mg*cm^{-3}), E) Percentage of Resilient species, F) Relative Abundance of Resilient species, G) Number of dense abiotic species (Species with abiotic disperse syndrome and wood density>0.7 mg*cm^{-3}), H) Percentage of dense abiotic species, I) Relative Abundance of dense abiotic species. Gray line shows the tendency of the glm fitting model and the confidence interval.

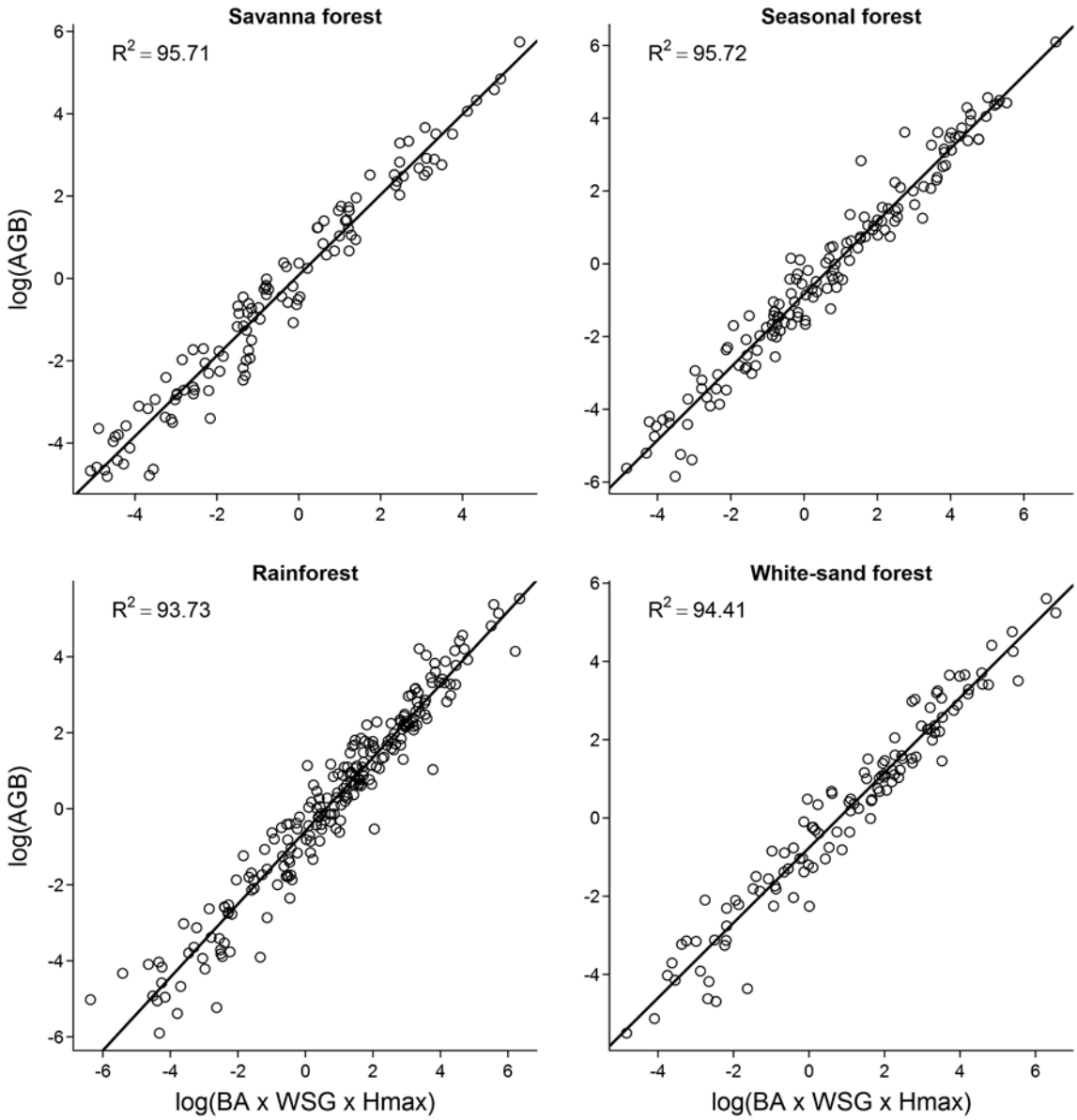

Figure S6. Linear regression of the above-ground biomass (AGB) and the proxy of basal area (BA) times the wood specific gravity (WSG) times maximum height for the different types of forest. Each circle represents the values of AGB and BA×WSG × MaxHeight estimated for each species at each site. The trend line is the result of the linear regression model. It is presented with the value of the adjusted-R^2.

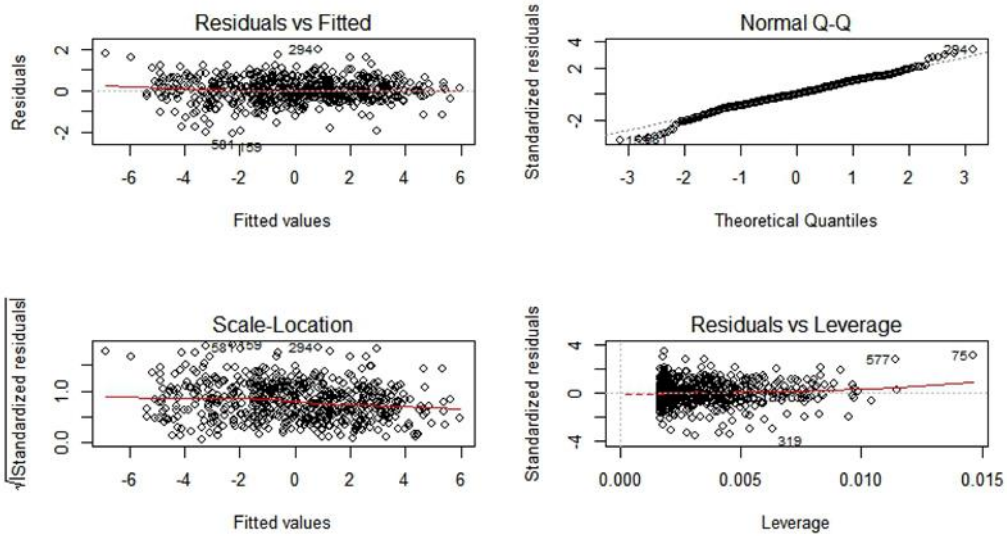

Figure S7. Diagnostic plots of the regression model using basal area (BA) times the wood specific gravity (WSG) times tree maximum height (MaxHeight) as a proxy of AGB. a) Residual vs. fitness, b) Normal distribution of the residuals, c) Scale Location of the standardized residuals, d) Leverage distance. In red is showed the trend line of the residuals.

Tables

Table S1. Traits information of the 2014 species analyzed. Available in file "Table 1S_Trait Data.xls". Seed_type= type of seed related to desiccation. sind=Dispersion syndrome , fdiam=fruit diameter(mm), flen=fruit length (mm), seeddiam= seed diameter (mm), seedlen= seed length (mm), wooden=wood density (g/cm^3), tre.size.max= max height reached by the species (m).

Table S2. **Atlantic Forest Communities analyzed, their spatial localization in Brazil, and abiotical characteristics**. Site code= short name of each community. State= Brazilian states. **C**ounty= Brazilian counties. Latitude and Longitude in decimal degrees. Altitude (masl). Temp= annual mean temperature in °C. PP=Annual precipitation in (mm). Plot=Plot size in hectares. Forest= Forest size in hectares. Reference= Reference of phytosociological data of each community.

Site Code	State	County	Locality	Latitude	Longitude	Altitude (masl)	Temp (°C)	PP (mm /year)	Plot (ha)	Forest (ha)	Refe
Almuri	Al	Murici	EEc de Murici	-9.21444	-35.8706	588	21.2	1778	1.05	2634	(*188*)
BAcabra	BA	Santa Cruz de Cabrália	RPPN Estação Veracel	-16.3658	-39.1767	104	23.9	1471	1.2	8820	(*189)*
ESsoor	ES	Linhares	REBIO de Sooretama	-19.064	-39.885	52	24.0	1227	1	17707	(*190*)
MGitamo1	MG	Itamonte	APA Serra da Mantiqueira	-22.3653	-44.8089	1652	14.5	1889	2.4	7384	(*191*)
MGperd1	MG	Dionísio	Zona de Amortecimento do PE do Rio Doce	-19.7983	-42.5139	298	23.3	1135	1.2	1500	(*192*)
MGperd11	MG	Timóteo	Frag 099	-19.6849	-42.5543	307	23.4	1150	6	34126	(*193*)
PRdiam3	PR	Diamante do Norte	EEc de Caiu	-22.592	-52.889	268	22.8	1233	1.08	1435	(*194*)
PRquedas2	PR	Quedas do Iguaçu	Faz Rio das Cobras	-25.4833	-52.8833	544	18.3	1784	1.63	4336	(*195*)
PRquedas3	PR	Quedas do Iguaçu	Faz Rio das Cobras	-25.477	-52.824	654	18.0	1795	1.63.	4336	(*195*)
PRtama1	PR	Tamarana	TI Apucaraninha	-23.852	-50.967	608	19.4	1450	1	4100	(*196*)
RJpeig2	RJ	Angra dos Reis	PE Ilha Grande	-23.091	-44.27	500	21.6	1451	1.02	15909	(*197*)
RJpnrj	RJ	Carapebas	PARNA da Restinga de Jurubatiba	-22.25	-41.6667	10	23.0	1112	1.44	3629	(*198*)
SCblum1b	SC	Blumenau	Parque Natural das Nascentes	-27.048	-49.078	578	17.7	1663	1	273111	(*199*)
SCguat	SC	Guatambu/Chapeca	FLONA de Chapeca	-27.098	-52.77	550	19.4	1960	1.56	1266	(*200*)
SCponte	SC	Ponte Serrada		-26.8211	-51.9792	1037	16.0	2054	1.56	3239	(*200*)
SCvolta	SC	Itapoã	Reserva de Volta Velha	-26.0667	-48.6333	11	21.2	1888	1	10910	(*201*)
SPeec1	SP	Gália	EEc de Caetetus	-22.4112	-49.7011	577	20.7	1281	10.24	3331	(*202*)

SPeec2	SP	Gália	EEc de Caetetus	-22.4182	-49.7015	543	20.8	1278	5.76	3331	(*203*)
SPeec3	SP	Gália	EEc de Caetetus	-22.3944	-49.7083	610	20.1	1301	5.76	3331	(*204*)
SPeec4	SP	Gália	EEc de Caetetus	-22.3818	-49.6834	680	20.0	1305	1	3331	(*205*)
SPigua1	SP	Iguape	EEc de Itatins	-24.5	-47.25	17	22.0	1905	1	5675	(*206*)
SPiper2	SP	Iperó[3]	FLONA de Ipanema	-23.4333	-47.625	733	18.8	1202	1.12	2379	(*207*)
SPmatao2	SP	Matão	Faz Boa Vista	-21.6206	-48.5372	589	21.4	1316	1	2353	(*208*)
SPpecb1	SP	Sete Barras	PE Carlos Botelho	-24.1814	-47.925	347	19.4	1546	10.24	457617	(*202*)
SPpecb2	SP	Sete Barras	PE Carlos Botelho	-24.125	-47.9351	526	18.2	1451	5.76	457617	(*209*)
SPpecb3	SP	São Miguel Arcanjo	PE Carlos Botelho	-24.0604	-47.9833	789	17.4	1386	5.76	457617	(*210*)
SPpei1	SP	Sete Barras	PE de Intervales	-24.2333	-48.0667	64	22.0	1613	1.98	457617	(*211*)
SPpesm6	SP	Ubatuba	PE da Serra do Mar (Núcleo Picinguaba)	-23.3817	-44.8401	1	23.3	2428	1	1428	(*212*)
SPpesmG	SP	Ubatuba	PE da Serra do Mar (Núcleo Picinguaba)	-23.3739	-45.0808	364	20.8	2397	1	85326	(*213*)
SPpesmK	SP	São Luiz do Paraitinga	PE da Serra do Mar (Núcleo Santa Virginia)	-23.3253	-45.0686	1030	16.5	1734	1	85326	(*214*)
SPpesmN	SP	São Luiz do Paraitinga	PE da Serra do Mar (Núcleo Santa Virginia)	-23.3433	-45.0728	1052	16.2	1760	1	85326	(*214*)

Table S3. **Spearman correlations among dispersal traits and carbon traits.** In parenthesis p-values and number of species involved (N). Upper diagonal shows correlation for the whole database. Below the diagonal, correlations for the animal-dispersed species.

	Seed diam (log)	**Seed length (log)**	**Wood density**	**Tree size max (log)**	**Fruit diam (log)**	**Fruit length (log)**
Seed diameter (log)		0.85 (<0.001, N 1053)	0.22 (<0.001 N 732)	0.21 (<0.001 N 1087)	0.59 (<0.001 N 1083)	0.50 (<0.001 N 1057)
Seed length (log)	0.90 (<0.001 N 743)		0.21 (0.001 N 721)	0.24 (<0.001 N 1013)	0.54 (<0.001 N 983)	0.59 (<0.001 N 950)
Wood density	0.28 (<0.001 N 486)	0.23 (0.001 N 473)		-0.0003 (0.96 N 833)	0.15 (<0.001 N 818)	0.13 (<0.001 N 802)
Tree size max (log)	0.25 (<0.001 N 783)	0.26 (<0.001 N 705)	-0.06 (0.17 N 557)		0.079 (<0.001 N 1156)	0.19 (<0.001 N1290)
Fruit diam (log)	0.60 (<0.001 N 811)	0.57 (<0.001 N 710)	0.15 (<0.001 N 586)	0.26 (<0.001 N 958)		0.76 (<0.001 N 1496)
Fruit length (log)	0.58 (<0.001 N 787)	0.62 (<0.001 N 677)	0.08 (0.03 N 570)	0.29 (<0.001 N 1014)	0.77 (<0.001 N 1218)	

Table S4. *T* test between carbon loss in random scenarios and defaunated scenarios at different intervals of species removed. All values significant at the Bonferroni-corrected p level.

% of species removed	**t test**	**P value**
10	3.549	0.0009
20	3.443	0.0012
30	3.346	0.0016
40	3.484	0.0011
50	3.296	0.0019
60	3.353	0.0016
70	3.388	0.0015
80	3.233	0.0024
90	3.237	0.0023
100	3.134	0.0031

Table S5. Generalized linear models results showing the influence of abiotical and compositional variables on the magnitude of carbon loss of each community.
Percentage endanger = Number of species with seed size > 12 mm / Number of species , Quantity endanger= Number of species with seed size > 12 mm, Percentage endanger IND = Number of individuals of species with seed size > 12 mm / Number of individuals , Percentage Resilient Hardwood = Number of species with seed size < 12 mm and wood density>0.7 mg/cm^3/ Number of species , Quantity Resilient Hardwood= Number of species with seed size < 12 mm and wood density>0.7 mg/cm^{3,} Percentage Resilient Hardwood IND= Number of individuals of species with seed size < 12 mm and wood density>0.7 mg/cm^3/ Number of individuals Percentage abiowood= Number of abiotic species with wood density>0.7 mg/cm^3 / Number of species, Quantity abiowood= Number of abiotic species with wood density>0.7 mg/cm^3, Percentage abiowood IND= Number individuals of abiotic species with wood density>0.7 mg/cm^3 / Number of species

	Coeficient	**p**	**Pseudo R^2**
Temperature	0.30	0.03	0.19
Percentage Resilient Hardwood IND	-2.08	0.01	0.17
Forest Size	-0.14	0.12	0.07
Quantity Danger	-0.02	0.19	0.05
Percentage Danger	-2.65	0.26	0.04
Percentage Data	-1.49	0.28	0.03
Quantity Resilient Hardwood	-0.01	0.38	0.02
Longitude	0.04	0.39	0.02
Percentage Danger IND	-1.99	0.40	0.02
Percentage Resilient Hardwood	-1.20	0.51	0.01
Latitude	0.03	0.51	0.01
Percentage Abiowood IND	0.45	0.56	0.01
Precipitation	0.00	0.71	0.01
Altitude	0.00	0.76	0.00
Quantity Abiowood	0.00	0.77	0.00
Percentage Abiowood	0.26	0.88	0.00

Table S6. **Compositional characteristics of Atlantic Forest Communities**. Site code= short name of each community. Percentage endanger = Number of species with seed size > 12 mm / Number of species , Quantity endanger= Number of species with seed size > 12 mm, Percentage endanger IND = Number of individuals of species with seed size > 12 mm / Number of individuals , Percentage Resilient Hardwood = Number of species with seed size < 12 mm and wood density>0.7 mg/cm^3/ Number of species , Quantity Resilient Hardwood= Number of species with seed size < 12 mm and wood density>0.7 mg/cm^3, Percentage Resilient Hardwood IND= Number of individuals of species with seed size < 12 mm and wood density>0.7 mg/cm^3/ Number of individuals Percentage Abiowood= Number of abiotic species with wood density>0.7 mg/cm^3 / Number of species, Quantity Abiowood= Number of abiotic species with wood density>0.7 mg/cm^3, Percentage Abiowood IND= Number individuals of abiotic species with wood density>0.7 mg/cm^3 / Number of species

Site Code	Quantity Endanger	Percentage Endanger	Percentage Endanger IND	Quantity Resilient Hardwood	Percentage Resilient Hardwood	Percentage Resilient Hardwood IND	Quantity Abiowood	Percentage Abiowood	Percentage Abiowood IND
Almuri	20	26%	18%	18	23%	20%	3	4%	10%
BAcabra	34	23%	23%	41	28%	37%	14	10%	6%
ESsoor	47	28%	21%	46	27%	33%	24	14%	20%
MGitamo1	9	8%	1%	38	32%	46%	10	8%	9%
MGperd1	37	15%	16%	58	23%	19%	34	14%	9%
MGperd11	66	15%	11%	92	21%	32%	46	10%	15%
PRdiam3	4	6%	6%	20	31%	38%	10	16%	6%
PRquedas2	3	5%	4%	11	18%	35%	7	11%	8%
PRquedas3	3	7%	2%	7	16%	11%	5	11%	16%
PRtama1	3	5%	6%	16	24%	18%	13	20%	16%
RJpeig2	36	17%	8%	90	42%	43%	8	4%	6%
RJpnrj	9	14%	14%	21	33%	36%	4	6%	4%
SCblum1b	5	11%	5%	19	40%	67%	3	6%	1%
SCguat	8	17%	14%	8	17%	24%	2	4%	0%

SCponte	3	6%	2%	7	14%	16%	7	14%	23%
SCvolta	14	16%	13%	34	40%	32%	3	3%	1%
SPeec1	7	6%	3%	25	20%	5%	25	20%	60%
SPeec2	6	5%	3%	25	20%	6%	22	18%	65%
SPeec3	10	7%	3%	35	24%	16%	29	20%	50%
SPeec4	5	7%	4%	17	25%	29%	13	19%	30%
SPigua1	30	25%	16%	35	29%	45%	8	7%	8%
SPiper2	3	5%	2%	13	22%	6%	12	20%	5%
SPmatao2	4	5%	1%	20	23%	8%	24	28%	69%
SPpecb1	37	25%	23%	44	30%	59%	7	5%	3%
SPpecb2	37	20%	14%	62	34%	58%	8	4%	3%
SPpecb3	27	19%	19%	50	35%	46%	6	4%	3%
SPpei1	30	25%	25%	29	25%	56%	5	4%	2%
SPpesm6	9	14%	7%	30	46%	48%	1	2%	0%
SPpesmG	18	20%	21%	31	35%	52%	6	7%	3%
SPpesmK	18	18%	9%	40	40%	77%	1	1%	0%
SPpesmN	14	19%	12%	31	41%	71%	1	1%	0%